GWK Electronics Ltd

82 Sea Avenue, Rustington, West Sussex BN16 2DL, UK | Tel/Fax: +44 (0)1903 782345

www.gwkelectronics.com | Email: sales@gwkelectronics.com

Series 200

Electronic Liquid Level Transmitters

Instruction Manual

Contents

Section 1 - Introduction

The Series 200 Electronic Liquid Level Transmitter, providing reliable measurement and indication of liquid level or tank contents, consists of two interconnected units.

1) An electronic transducer carrying one of the following model numbers depending upon the mounting configuration.

   Model 200BS - Basic transducer

   Model 210 - External mounting (flanged)

   Model 220 - Fully immersible in-tank transducer (bracket mounting)

   Model 230 - Fully immersible in-tank transducer (pole mounting)

   Model 240B - External mounting (screwed connection)

   All the units are of the same fully immersible construction and are fitted with a length of electric cable up to 50m to specification requirements. The electric cable is of a special heavy duty Arctic grade, fuel oil and seawater resistant, and care should be taken in its installation.

2) An electronic amplifier/transmitter for installation outside the tank and to which the transducer is directly connected. The transmitter is housed in a weatherproof wall mounting enclosure.

1.1 Transducers

1.1.1 Model 200B Transducer

The Model 200B Transducer comprises a sensitive pressure measuring capsule assembly and a linear voltage differential transformer (LVDT) combined within a pressure tight enclosure of Type 316 stainless steel. The standard capsules are of Inconel X 750 or Inconel X 750, Epoxy coated for seawater resistance.

Under operating conditions, pressure acting upon the capsule assembly causes movement of a magnetic core within the field of the LVDT. The resultant signal Is electronically processed and Is directly proportional to the capsule deflection and to the pressure or liquid depth.

The transducer is supplied with a special electric cable to a length specified by the user. The cable is sealed to the transducer with a special glanding technique to prevent ingress of liquid under high pressure conditions. **Under no circumstances should any attempt be made to disconnect this cable without reference to the appropriate manufacturing specification sheet.**

1.1.2 Model 210 Transducer

The Model 210 Transducer is of the same general construction as the Model 200B Transducer above but is for external mounting. The instrument is fitted with a standard flange which may be bolted directly to a mating flange on the side of the tank (customer to supply) or to an isolating valve which would permit removal of the instrument without emptying the contents of the tank.

1.1.3 Model 220 Transducer

The Model 220 Transducer is of the same general construction as the Model 200B Transducer above, but is provided with a separate clamp/bracket for mounting the transducer inside a tank or vessel, either on the side wall or on the bottom.

1.1.4 Model 230 Transducer

The Model 230 Transducer is of the same general construction as the Model 200B Transducer described above but is supplied with a pole mounting flange. This pole flange or adaptor is fitted to the end of a 25mm pipe by welding or screwing or both. This mounting is used where it is necessary to install the transducer from above.

1.1.5 Model 240 Transducer

The Model 240 Transducer is of the same general construction as the Model 200B above, but is for external tank mounting via a threaded connection to permit mounting direct to a tank boss or screwed isolating valve.

1.2 Electronic Transmitter

The function of the transmitter unit is to supply the driving signal to the transducer and to amplify the corresponding return signal to provide a 4-20mA DC analogue output for onward transmission to an indicator, recorder or other equipment. This output signal is generally described as a "two wire" loop and the transmitter derives all its necessary power from an 18-30 v DC supply (see drawing 200/GWA/1). Range and zero adjustment potentiometers are available for calibration of the transducer after installation, although transducer and transmitter would normally be supplied connected and calibrated to suit the customers particular requirements and should be installed in their matched pairs, i.e. at the time of delivery both transducer and transmitter will bear the came serial number, the transducer carrying the suffix letter 'A' and the transmitter carrying the suffix letter 'B'.

1.3 Ancillary Equipment

The standard output transmission signal of 4-20mA is suitable for driving a wide variety of equipment which accepts the same standard input signal. Apart from indicators, other items of equipment may be included into the loop to provide alarms, control, specific gravity scaling, computers and other devices.

Section 2 - Installation Notes

2.1 Pre-Installation Checks

Prior to despatch each system is calibrated to the requirements specified by the user. This requires the units of the system to be matched and identified by labelled reference. It is therefore essential that a check for correct matching is made before any of the units are installed **to ensure that the correct transducers and transmitters are fitted to their designated tanks.**

2.2 Transducers

2.2.1 Model 200B Transducer

The Model 200B Transducer is the basic transducer and may be installed freely suspended in any liquid level situation where free suspension is acceptable, e.g. shallow tanks, static water reservoirs etc.

2.2.2 Model 210 Transducer

The Model 210 Transducer is fitted with a standard 40mm or 50mm nominal bore DIN flange.

A suitable mating flange should be securely welded to the tank to ensure that the centre height of the flange is strictly in accordance with the desired fitting height of the transducer. The transducer may be bolted directly to this flange or, for removal of the transducer at a later date, an isolating valve may be fitted between the tank flange and the transducer flange.

Once mounted, the cable which is scaled to the transducer should be carefully clipped or adequately protected and run to the associated transmitter.

2.2.3 Model 220 Transducer

The Model 220 Transducer is designed for clamp/bracket mounting inside a tank, either on the side wall or on the bottom (see Drawing No.200/GIA). This transmitter is factory calibrated to meet specific user requirements and must, therefore, be fitted in the tank **in the specified position and at the specified height.** The fitting height of the transmitter is always determined by the capsule position and the capsule position is considered the datum point.

Drawing 200/GMA gives the relevant dimensional detail for the fixing of clamps/brackets with respect to the final capsule position.

The brackets may be mounted by means of studs welded to the inside of the tank or by direct welding to the tank. After mounting the transducer, the free end of the cable should be fed through the tank wall by means of a double cable gland or bulkhead fitting to ensure a leak tight seal. The cable may also be protected with a conduit or nylon piping, or similar according to the required regulations.

2.2.4 Model 230 Transducer

The Model 230 Transducer is supplied with a special adaptor flange for mounting the transducer directly to a 1"/25mm o.d. pipe, in such a way that the transducer will be suspended at the end of the pipe (see Drawing No. 200/GMA).

The pipe must be accurately cut to length and threaded 3/4" BSP or prepared for welding to the adaptor. The adaptor may be welded or both screwed and welded to the support pipe. In all cases care must be taken to ensure that the final position, with respect to the capsule height above the tank bottom, is as specified by the user prior to manufacture.

After fitting the adaptor to the support pipe, the 'O' ring seal should be passed over the free end of the cable and the cable pulled through the supporting pipe until the rear end of the transducer locates with the adaptor. Ensure that the 'O' ring is correctly located in the 'O' ring groove and, with the bolts provided, secure the transducer. A pressure tight seal will now have been created between the transducer and the flange and so the enclosed cable will be isolated from the tank medium.

The top end of the pipe or pole should be prepared with another flange for bolting to a mating flange in the tank top or tank manhole cover plate.

This flange should be fitted with a suitable cable gland through which the transducer cable can be passed and secured before being run to the transmitter.

2.2.5 Model 240 Transducer

The Model 240 Transducer has a threaded connection for direct mounting to a screwed tank boss or isolating valve, the centre of which will be of the specified height above the tank bottom. The threaded connection is 3/8" BSP male.

2.3 Wall Mounting Transmitter

The transmitter unit is provided with a weatherproof wall mounting GRP enclosure to IP65 and should be located at a convenient position outside the tank.

Two cable glands are provided in the housing, one to accept the transducer cable and the other for the two wire supply/signal cable.

2.4 Sensor/Transducer Cable

The cable will normally be prepared and bared to the correct length in works and it is not recommended that the cable be shortened, any surplus being neatly coiled. Shortening the cable may require re-calibration.

The cable contains the following elements which should be identified. Four individual cores, each insulated with a coloured sheath, screened, a strand of strain wire and nylon vent tube.

Care should be taken to ensure that the cable is never installed in a manner producing bends of less than 50mm radius; this is to ensure that any crimping or collapsing of the vent tube is avoided. The cable should be fed through conduit or neatly clipped in accordance with good practice and local regulations.

When a transducer is installed and the cable is in position as above, connect the transducer cable to the transmitter by passing the free end of the cable into the transmitter housing, via the cable gland, and connecting the four cores and screen in accordance with the wiring diagram 200/GW/1 at the rear of this section, leaving the vent tube free within the housing.

No attempts should be made to cut and re-join the cable as this would cause damage to the vent system. Where the cable is to pass through a tank wall, manhole cover or bulkhead, a suitable double watertight compression cable gland should be used.

2.5 Transmitter Wiring

As the electronic transmitter is of the two wire nominal 24 v DC supply type, both power for instrument and the milliamp transmission signal are carried down the same two cores. Any good quality three core cable will be suitable, e.g. 5mm to 9mm, 250 volt RMS grade with cable conductor size 16/0.2mm ($0.5mm^2$). This three core cable is run between the transmitter, the power supply and the auxiliary equipment/indicator. For maximum load resistance see next paragraph. If the cable is laid adjacent to high voltage cables, then this three core cable should be of a screened type.

The third core is connected to earth.

The power supply of 18-30 v DC, the indicator and any auxiliary equipment should be connected in the series mode in accordance with the wiring diagram 200/GWA/1. **No attempt should be made to connect this cable to mains supply.**

2.6 Wiring of Auxiliary Equipment

All items of equipment required to be connected to the output of the transmitter should be connected in the series mode configuration, as shown in Drawing No.200/GWA/1.

All auxiliary items must be of the 4-20mA input type and the circuit load resistance should not exceed a maximum of 875 ohms. This is the maximum output load of the transmitter when the maximum supply of 30 volts DC is available. The maximum load resistance can be readily calculated as follows:

$$\frac{\text{Supply Voltage - 12.5}}{\text{Current i.e. 0.020A (Full-scale output)}} \quad \text{OHMS}$$

It is strongly recommended that the loop load should not be allowed to exceed 90% of the maximum load resistance; otherwise overload conditions may not be correctly indicated or recognised.

2.7 Indicators

A wide variety of indicators, both analogue and digital, are suitable for use with the Series 200 system. Always check that the indicator has been correctly calibrated and that the instrument is connected to the tank for which it has been calibrated and is intended.

2.8 System Interconnections

Warning: **The SERIES 200 Electronic Level Transmitter is designed to operate on the 18-30 v DC signal level and no attempt should be made to connect any part of the transducer, the transmitter to high voltage mains supplies.**

Wiring should be strictly in accordance with the single loop general diagram Drawing No. 200/GWAII.

Section 3 - Operation and Maintenance

3.1 Product Inspections

When correctly installed the Series 200 system will provide continuous indication and a satisfactory performance over a long period may be expected. None of the units are subject to mandatory inspection requirements and no routine maintenance is required, but the following checks are recommended to be made from time to time.

3.1.1 Routine Cheeks

1) System components should be checked visually to ensure that enclosures are properly secured and that doors and lids are firmly closed, also weatherproof gaskets and seals should be examined for condition and security.

2) Electric cable runs between the various system components should be inspected for condition and security and all cable glands should be kept securely fastened.

3.1.2 Non-routine Cheeks

In the event of the sensor being so located as to permit the accumulation of sludge within the pressure sensor chamber, cleaning may be required from time to time and the following procedure should be adopted.

1) Remove the transducer to a suitable location for working and clean and dry the unit externally as necessary.

2) Remove the transducer end cap or flange in order to gain access to the pressure sensor/capsule chamber. Never try to insert tools or cleaning probes into the capsule chamber via the holes in the end cap as this is almost certain to cause damage to the sensitive pressure capsule.

3) Using suitable solvents and clean water carefully clean the sludge deposits from the chamber and remove any accumulation from around the pressure capsule.

4) Clean and inspect the 'O' ring before re-assembly and ensure that it is properly seated. Fit a new 'O' ring if necessary.

5) Refit the transducer end cap or flange, taking care not to damage the rim of the capsule, and screw back into place, tightening with hand pressure only.

3.2 Fault Finding and Check List

If after installation it is found the system is giving incorrect readings or no readings at all, the following list of cheeks should be performed in sequence.

The instrument performs a complex function and is only as good as the information it is given, so it must be established that the transmitter is being fed with the information appropriate to its calibration.

3.2.1 Indicator reading is zero or above Full-Scale

1) Confirm the system is connected to the tank for which it has been calibrated.
2) Confirm presence of medium by dipping the tank and that the tank is freely vented.
3) Confirm that any transducer isolating valve (in the case of external transducers) is in the open position.
4) Confirm that the tank contents are fluid at the transducer; i.e. no solids or blockage.
5) Confirm the system is wired in accordance with the wiring diagram.
6) Confirm power is switched on and the correct voltage is monitored between terminal M and the - ve terminal by connecting a DVM set to read 0-200 millivolts DC. Reading should be in the range 40-200 millivolts. Cheek that power supply is correct polarity.
7) Confirm that the current output from the transmitter appears at the indicator terminals.
8) Cheek that the indicator is not fitted with transit stops or bridges.

3.2.2 Indicator reading is found or thought to be Inaccurate

1) Confirm that the indicator is fitted to the tank for which it has been calibrated.
2) Check calibration details from the worksheets supplied with the instruments against the original ordered information supplied by the user.
3) Check that the above information is still correct with respect to the actual tank dimensions as these may sometimes have been changed.
4) Confirm that the tank is freely vented.
5) Remove transducer from the tank after ensuring safety and security of contents.
6) Confirm transducer capsule is clean and free from obstruction.
7) Connect the transducer and transmitter to a calibration pressure test source and accurate digital or analogue read-out unit. Refer to sections on "Calibration and Test Procedures".
8) Carry out **complete** test and calibration of transmitter, transducer and indicator.

3.3 Customer Calibration and Test Procedures

Systems will normally be provided pre-calibrated to user requirements and if all information has been supplied correctly and all dimensional and quantity parameters have remained unchanged, the system may be regarded as ready for use as delivered.

However, there may be occasions where some slight adjustment is required due to changes in information given in respect of the vessel or the medium, and the system may be adjusted on site to take account of these changes.

3.3.1 Basic RANGE and ZERO adjustment

There may be occasions when a system appears to give an incorrect output signal in relation to the known level. This can occur if the final "as made" fitting height of the transducer is not in accordance with the original design fitting height. Also tank dimensions may vary from original design drawings. For adjustment in these situations, the Series 200 Transmitter is provided with both RANGE and ZERO potentiometers. However, **do not adjust the controls unless examination of the design criteria suggests that it is necessary and always ensure that the fault finding check list has been fully complied with.**

For testing and calibration of the Series 200 system, the following equipment is recommended:

a) An accurate pressure source. As the instrument has an accuracy of better than 0.5% it is recommended that calibration source equipment should be of an order of accuracy of 0.1% or better.

   An air driven dead weight tester, precision laboratory digital pressure standard, water and mercury columns are suitable as primary pressure sources.

b) A digital voltage or current meter.

c) A standard resistance.

d) Suitable pressure fittings and couplings.

The following procedure should be adopted bearing in mind that the transmitter is of the live zero pattern (i.e. 4-20mA) which gives an immediate indication that the system is powered.

1) Connect the transducer and transmitter to the pressure source and associated test equipment, ensuring that the specified length of inter-connecting cable has been fitted between the transmitter and the transducer.

2) When there is no pressure applied to the transducer, adjust the ZERO potentiometer to provide a 4mA output signal.

3) Apply a pressure to the instrument equivalent to the full nominal range input of the capsule. This full nominal range will be printed on the instrument identification plate. Release the pressure and re-check the zero position and adjust if necessary.

4) Apply the full actual range of input pressure required (possibly less and different from the full nominal range) and adjust the RANGE potentiometer to give a 20mA output.

5) Cheek the linearity and performance of the instrument by checking the 25%, 50%, 75%, 100% positions, both on increasing and decreasing pressure. Check that the overall performance is within that specified. Linearity adjustment is not available and so if linearity is far outside the specification, the instrument should be returned to works for inspection and repair.

6) The transducer and transmitter may now be returned to service.

3.3.2 Complete Calibration and Test Procedures

To be employed in the event of the replacement of capsules, transmitters, transducers/cable.

1) Ensure the correct specified length of 4 core cable has been fitted to the transducer and connect the 4 cores into the transmitter terminal block.
2) Connect the 24 volt supply to the transmitter, but do not switch the power supply on.
3) Set the PHASE, PRE-SET RANGE (Marked RV3) CUSTOMER RANGE and ZERO potentiometers as follows:
4) Turn the PHASE potentiometer fully anti-clockwise.
5) Turn the PRE-SET RANGE potentiometer fully anti-clockwise and then clockwise one half turn.
6) Turn the CUSTOMER RANGE potentiometer fully anti-clockwise until a click is heard and then clockwise four full turns.
7) Turn the ZERO potentiometer fully anti-clockwise until a click is heard and then clockwise five full turns.
8) Switch on 24 volt power supply.
9) Connect Earth lead to transducer body.
10) Connect the transducer to a suitable pressure source and pressure measuring equipment.
11) Position the transducer in the correct attitude for calibration, i.e. either vertical or horizontal.
12) Set the zero pressure output to 4mA by adjusting the ZERO potentiometer.
13) Apply a pressure of 120% of full nominal range to the transducer and reduce the pressure to zero. Repeat this exercise three times.
14) Set the zero output to 4mA once again, if necessary.
15) Apply a pressure of full nominal range and adjust the PRE-SET RANGE potentiometer to give an output of 20mA ± 0.2mA.
16) Reduce the pressure to zero.
17) Apply a pressure of 25% of full nominal range and adjust the PHASE potentiometer to indicate the highest output for this pressure.
18) Reduce the pressure to zero and re-set to 4mA if necessary.
19) Apply a pressure of full nominal range and adjust the CUSTOMER RANGE potentiometer to indicate 20mA.
20) Reduce the pressure to zero.
21) Cheek the zero and nominal range outputs are correct.
22) To obtain the actual range setting, apply the actual range pressure and adjust the CUSTOMER RANGE potentiometer to indicate 20mA. Repeat as necessary until zero and actual range output are correct. For setting the actual range, adjustment should only be made to the ZERO and CUSTOMER RANGE potentiometers.
23) Check linearity at 25%, 50%, 75% and 100%.

3.4 Component Interchangeability

Under certain conditions, it may be found necessary to change or replace capsules (because of damage or to change of nominal range) or to replace total transmitter or transducer components within the system. To carry out these changes proceed as follows:

3.4.1 Replacement of Capsules

1) The capsule is fitted to the pressure housing base plate by a threaded boss and is sealed by means of an 'O' ring seated beneath the boss. Removal of the capsule may be undertaken by applying a narrow width hexagon spanner to the nut underneath the capsule. Extreme care should be taken when carrying out this operation and no attempt should be made to unscrew a tight capsule by holding the capsule itself. Unscrew the capsule as far as possible and then withdraw gently so as not to damage the transformer core which is attached to the centre of the capsule.

2) Fitting of a replacement capsule is the reverse of the above procedure except that it may be necessary to "re-null" the LVDT in which case proceed as follows:

   Carefully insert the capsule to its fully tight position and cheek the output signal at zero pressure. If it is not within an acceptable reading of 4mA plus or minus 0.2mA, or 4mA plus or minus 1% FS, remove the capsule and carefully adjust the position of the transformer core on its threaded support spindle. Very small adjustments of 0.1mm will have a significant effect on the output of the transmitter. Replace the capsule and cheek the position again. If necessary, continue with the above process until a satisfactory zero point is reached. Having reached this point remove the capsule and apply a minute amount of thread locking adhesive to the core support spindle thread. Replace the capsule and carry out **complete** calibration procedure as described above.

3.4.2 Replacement of Transmitter

If there is a failure in the transmitter necessitating replacement, or a transmitter is to be fitted to a transducer to which it has not been previously matched, **complete** calibration is necessary as detailed above under "Complete Calibration and Test Procedures".

3.4.3 Replacement of Transducer and/or Cable

In the event of failure, the transducer and/or cable may be changed complete and matched to the existing transmitter by carrying out **complete** calibration as detailed above under "Complete Calibration and Test Procedures".

3.4.4 Electromagnetic Interference Immunity

The transmitter has an earthing plate fitted to the base which is used for mounting the transmitter to a metal bulkhead (see Drawing No. 200/GIA LA). This method of mounting must be used to ensure full interference immunity to Lloyd's approval standard.

Section 4 - Intrinsically Safe Installations

4.1 Installation Conditions

When a Series 200 Electronic Liquid Level Transmitter is installed in a hazardous area, it is important that the following conditions are observed.

1. The equipment must be installed in accordance with drawing number GO 200/50.
2. The equipment must be installed in accordance with the requirements of B.S. 5501. Part 9. 1977. EN50 039 particularly with respect to clauses 4.1 and 5. In the UK it must also comply with B.S. 5345. Part 4. 1977.
3. Any electrical circuit which is connected to the Series 200 Electronic Level Transmitter in the hazardous area must be able to withstand a test voltage of 500V RMS with respect to earth for a period of one minute.
4. When the connection between the Safety Barrier and the Transmitter is part of a multicore, it should be of a Type A or Type B multicore cable as specified in clause 5.3 of B.S. 5501 Part 9. 1982. EN50 039. Any circuit included in the multicore should not have a peak voltage exceeding 60 volts.
5. Any Shunt Zener Diode Safety Barrier certified by BASEEFA or nay EEC approved body to Eex ia Iic, should have the following output parameters:

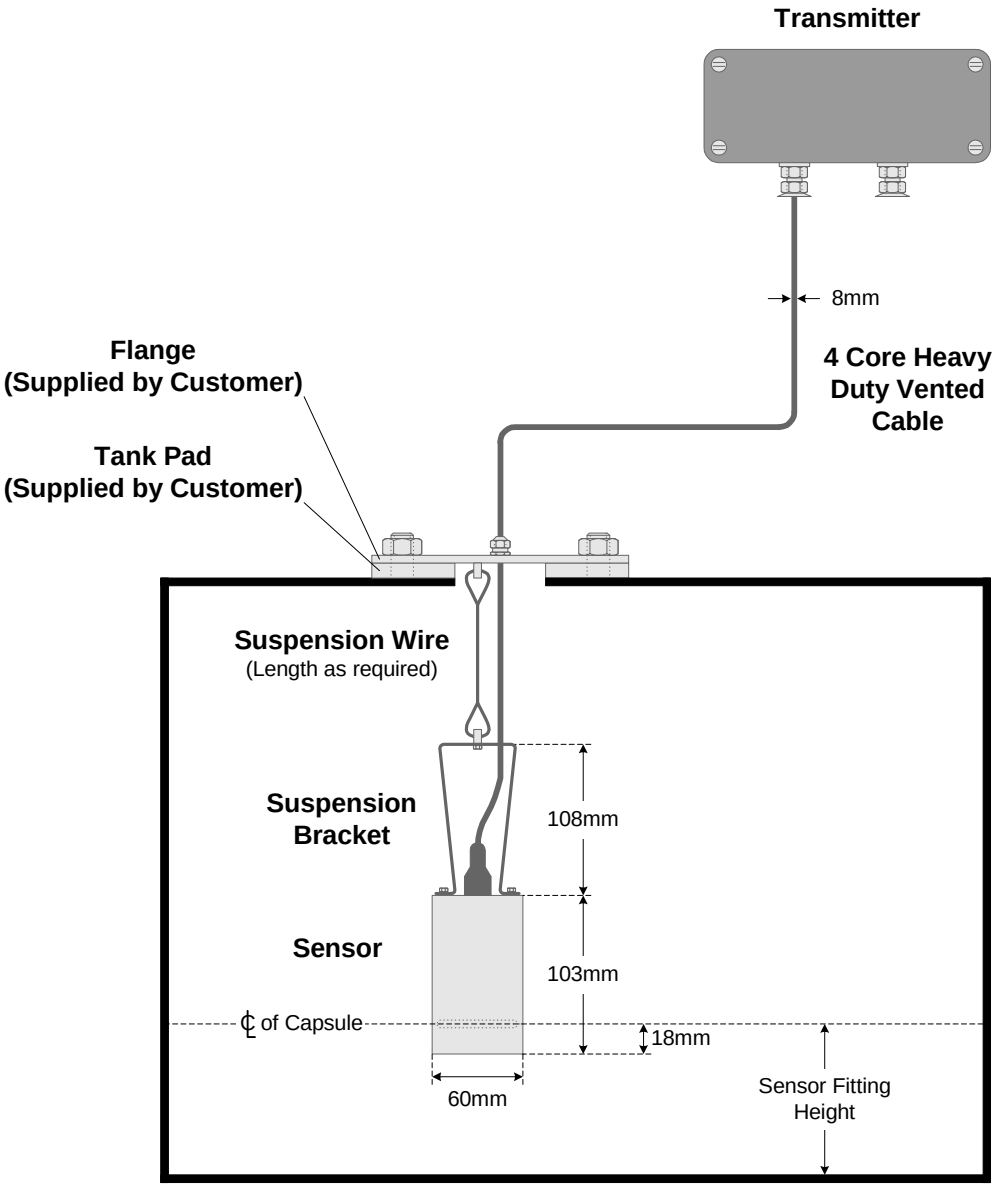
Uz	28V
I max Out.	93mA
W max Out.	0.66W

   Other barriers having lower values than these are permitted.
6. Unspecified apparatus may be connected to Safe Area terminals of the Safety Barriers but it must not contain under normal or abnormal conditions a source of potentil greater than 250V RMS or 250V DC.
7. Any cable screens must only be earthed at the Barrier Bus Bar Earth (see Drawing No. GO 200/50).

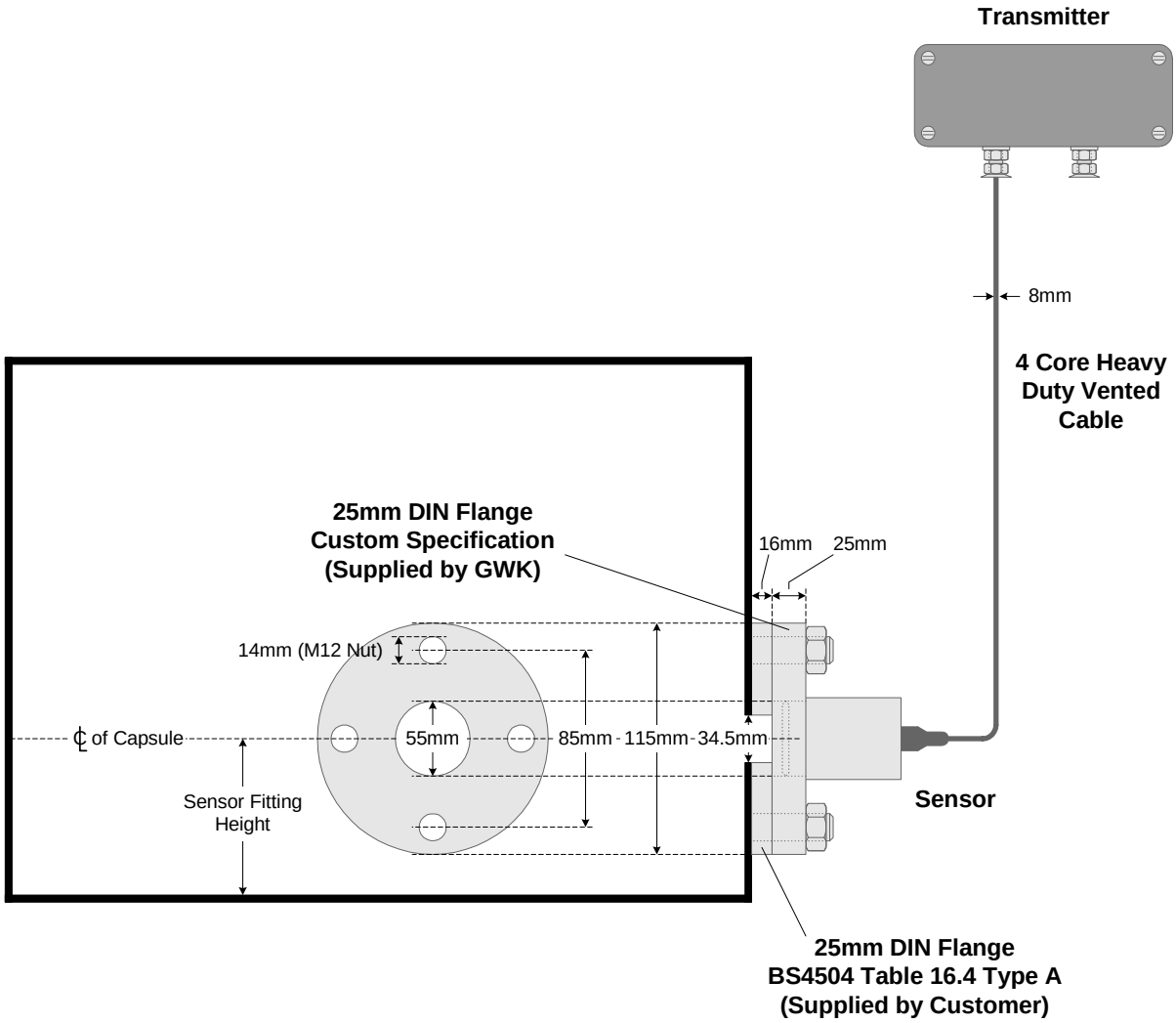
4.2 Inspection and Calibration

1. Any testing, inspection or calibration of the Series 200 Electronic Liquid Level Transmitter must be carried out in accordance with B.S. 5345 Part 4.
2. Any testing, inspection or calibration of the Series 200 Elect- ronic Liquid Level Transmitter in the hazardous area can only be undertaken on the issue of a Gas Free Certificate.
3. Removal of the cover of the Series 200 Electronic Liquid Level Transmitter in the hazardous area invalidates the I.P. protection required by the relevant Standard and should only be undertaken in the hazardous area when the conditions have been made safe by the control of the flammable material.

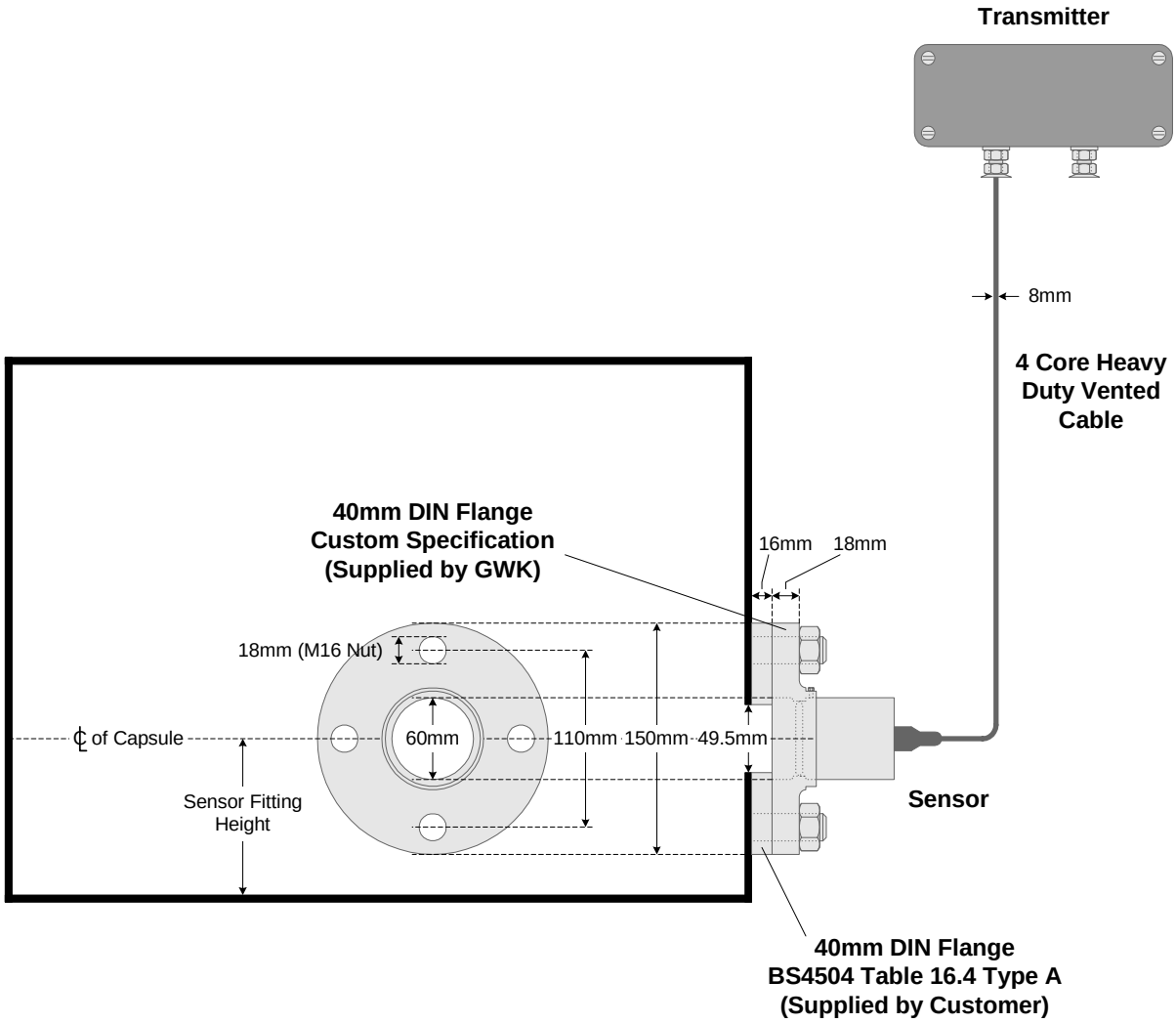
Appendix 1 - Model 200BS



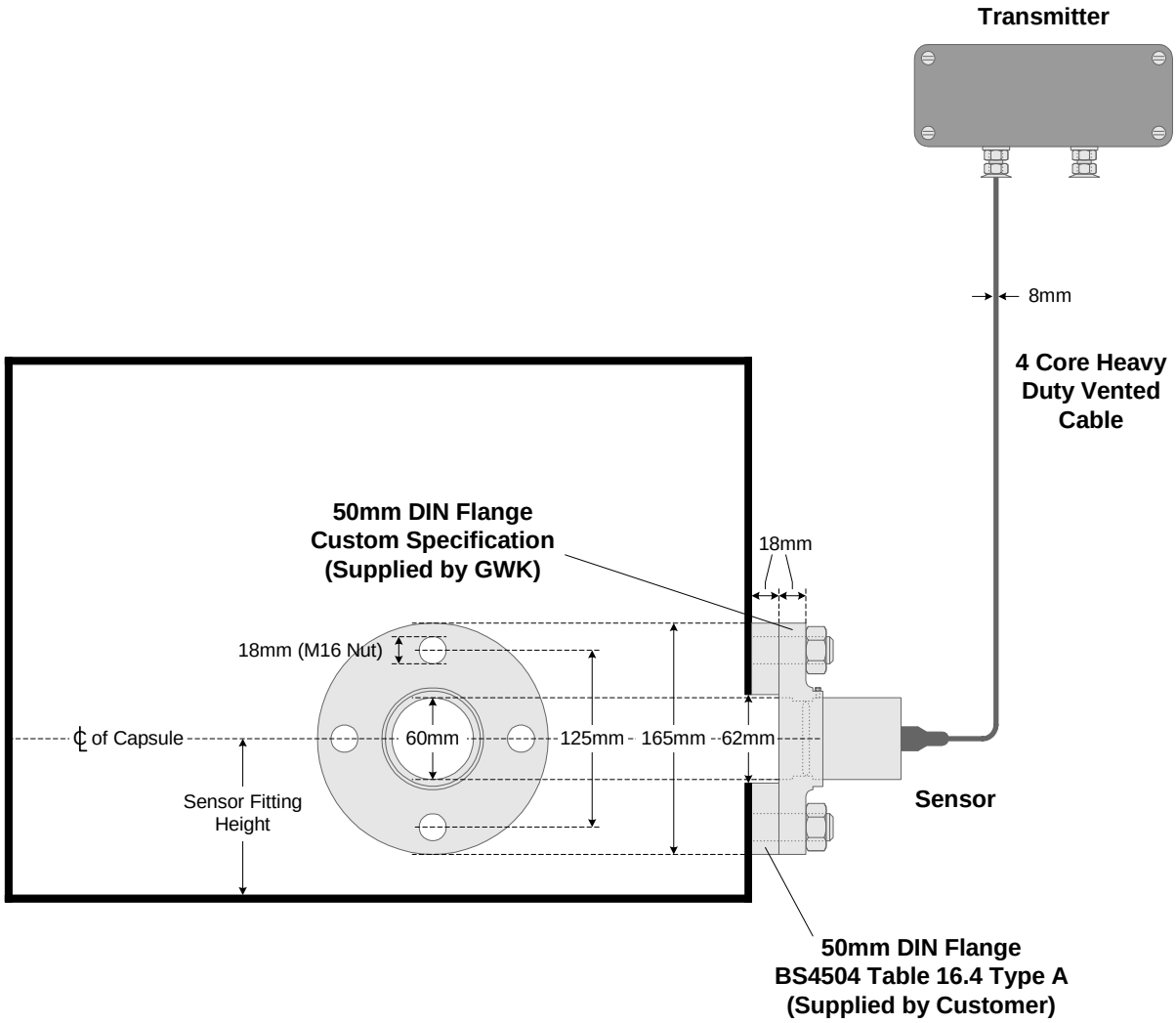
Appendix 2 - Model 210/25



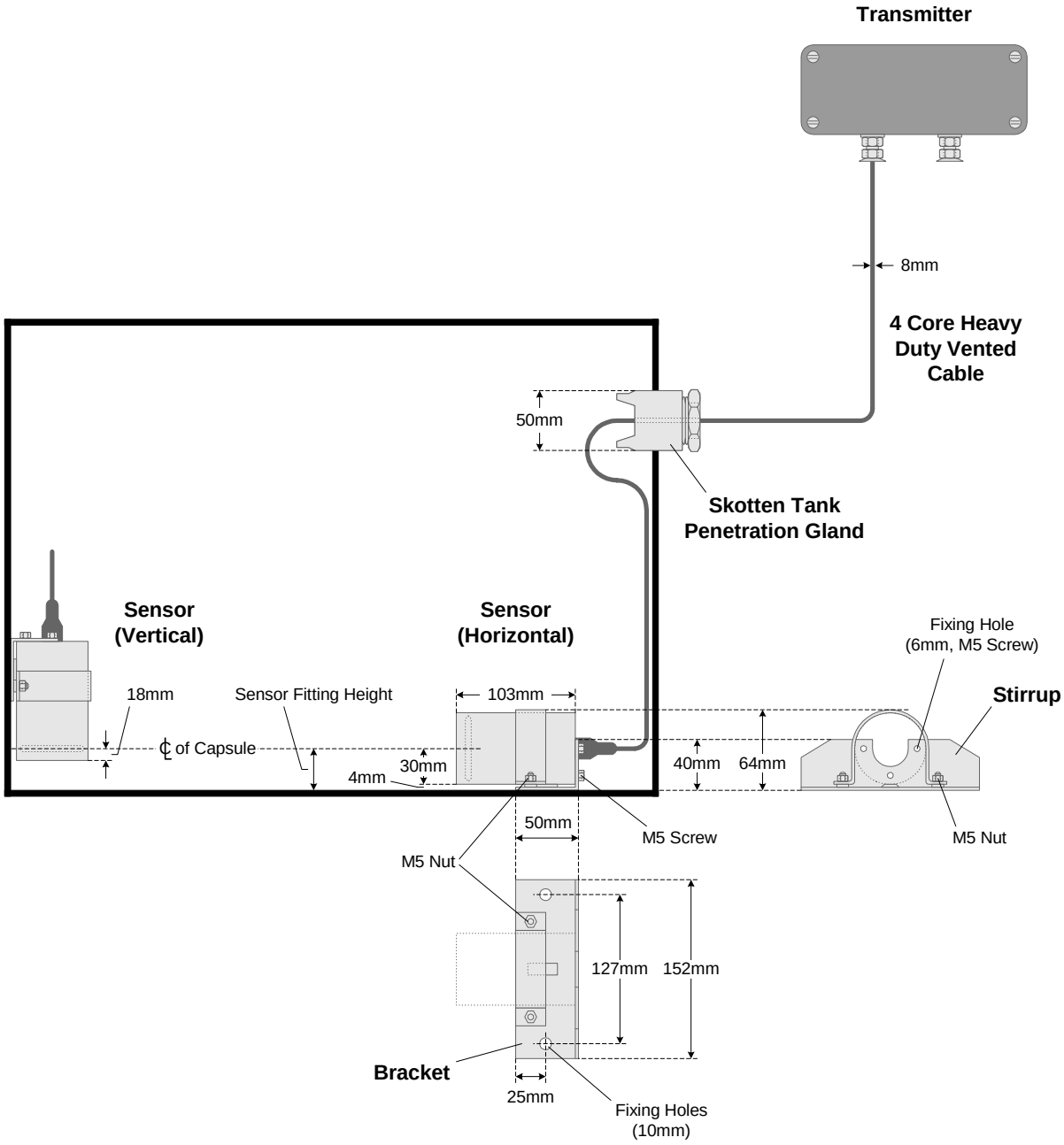
Appendix 3 - Model 210/40



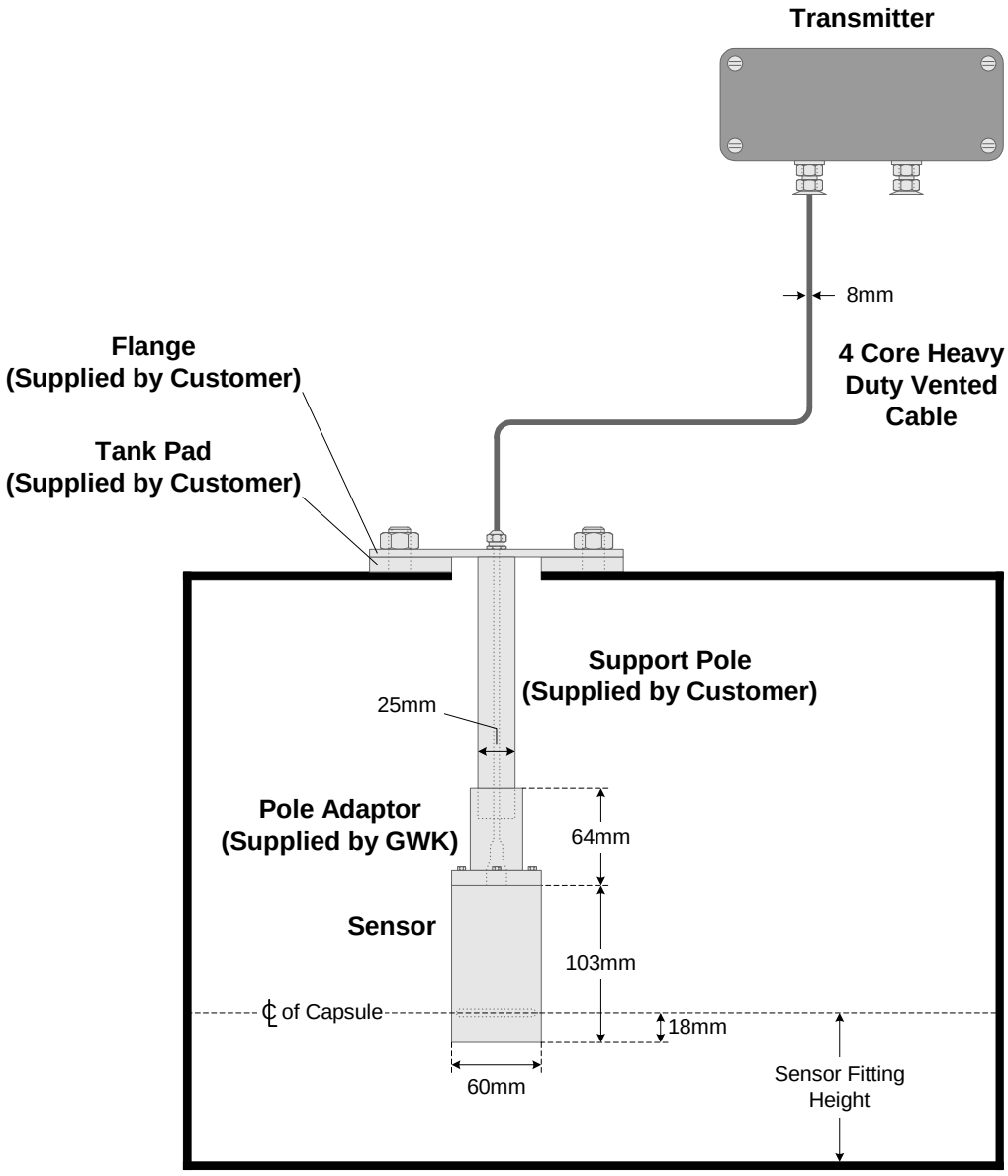
Appendix 4 - Model 210/50



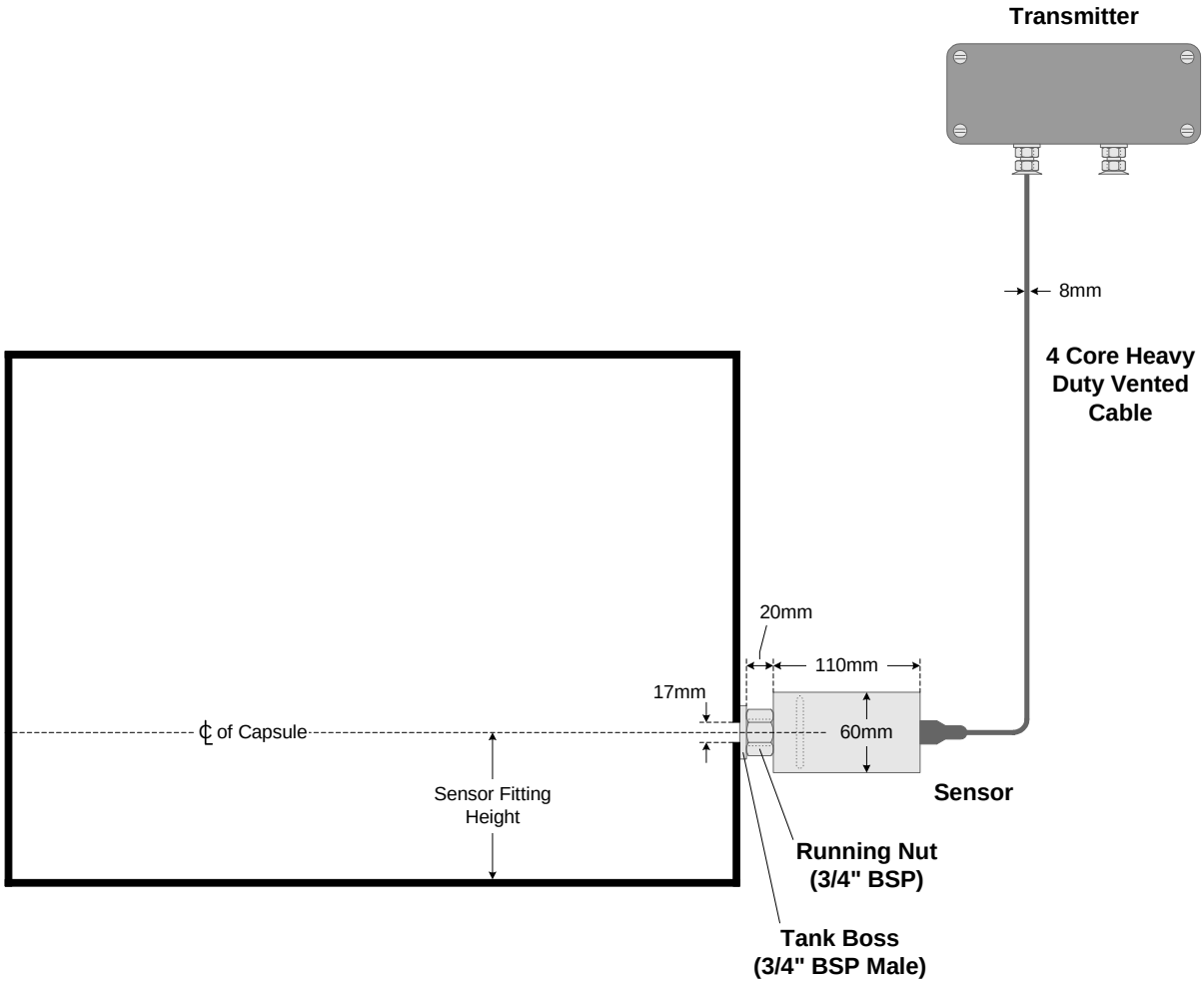
Appendix 5 - Model 220

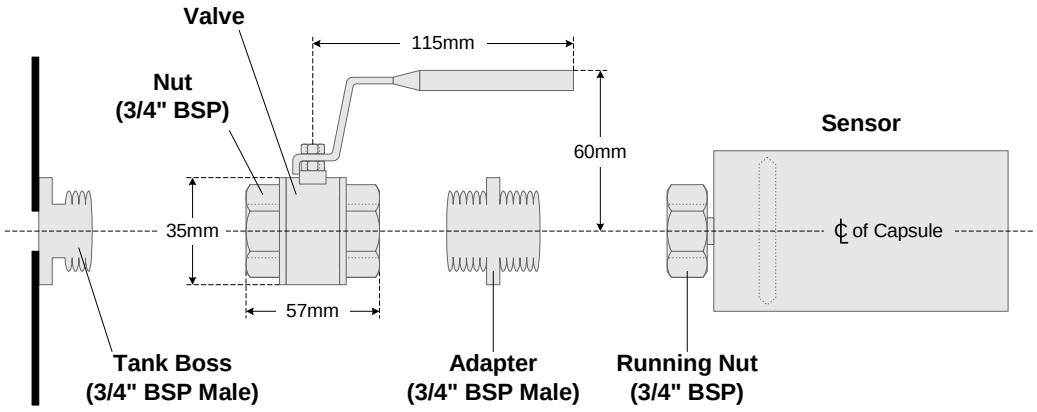


Appendix 6 - Model 230



Appendix 7 - Model 240B





Appendix 8 - Electonic Transmitter